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PLANT IMMIGRANTS

No. 199 November, 1922.

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Foreign Seed and Plant Introduction.

EXPLANATORY NOTE

This circular is made up principally of notes received from agricultural explorers, foreign collaborators, and correspondents, concerning the more important plants which have been received recently by the Office of Foreign Seed and Plant Introduction. It also contains reports on the behavior of plants which have been introduced in previous years.

Descriptions appearing here are revised and later published in the Inventory of Seeds and Plants Imported,-- the permanent record of plant introductions made by this Office.

Plant Immigrants should be considered merely an ANNOUNCEMENT OF THE ARRIVAL OF PLANT MATERIAL. As a rule all material is propagated before being distributed; this may require several years.

The Annual Catalogue of New Plant Introductions describes briefly the plants available for distribution. Application for seeds or plants listed in Plant Immigrants may be sent at any time, however, and will be filed in the order of their receipt. When material is ready for distribution, these requests will be given first attention; if their number is sufficient to exhaust the available supply of a given species, it will not be included in the Annual Catalogue.

Plant breeders and experimenters who desire plants not available in this country are invited to correspond with this Office which will endeavor to secure the required material through its agricultural explorers, foreign collaborators, or correspondents.

DAVID FAIRCHILD
Agricultural Explorer in Charge,
Office of Foreign Seed and Plant Introduction.

Issued Feb. 5, 1923. Washington, D. C.

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AMYGDALUS PERSICA (Amygdalaceae), 55775 and 55776. **Peach.** From China. Seeds collected by J. F. Rock, Agricultural Explorer of the Bureau of Plant Industry. Quoted notes by Mr. Rock.

55775. "(Near Puerhfu, Yunnan, July, 1922.) A tree 40 feet in height, which is a prolific bearer. The fruits are unusually fine, although small; they are juicy and of a delicious strawberrylike flavor, freestone, and with a strawberry-red surface."

55776. "(Puerhfu, Yunnan, July 10, 1922.) Seeds from large trees growing wild in the mountains 30 li (about 8 miles) from Puerhfu at an altitude of 5,000 feet. The fruits are large, freestone, quite juicy, and of good flavor."

AMYGDALUS PERSICA (Amygdalaceae), 55813. **Peach.** From the Plant Introduction Garden, Chico, Calif. A sucker from the stock plant on which was budded *Amygdalus tangutica*, S.P.I. No. 41709. Numbered September, 1922, for convenience in distribution. "This tree has matured a very good crop of exceptionally fine freestone peaches. The fruit is yellow with red cheeks, in shape slightly flattened at the ends and bulging in the center, in size about 3 inches in diameter and 2⅝ inches long. The basin is wide and shallow, the suture rather indistinct. The flesh is yellow, very juicy, of extra fine quality, and very red at the pit, which is rather large, rough, and deeply corrugated. Average weight about 6½ ounces. A number of persons who have sampled this peach have pronounced it superb. It compares favorably with 'Late Crawford,' and is about a week later than 'Elberta.' It is not as coarse in texture as the latter." (J. E. Morrow.)

ARACHIS HYPOGAEA (Fabaceae), 55808-55810. **Peanut.** From Buitenzorg, Java. Seeds presented by the Java Department of Agriculture through Carl Hartley. Quoted notes by Mr. Hartley.

55808. "(No. 24 M.) 'Broel.' This is a dominantly 3-seeded, red-skinned peanut from East Java. It is moderately wilt-resistant and matures in 100 days, or, according to the natives, in 3 months."

55809. "(No. 74.) 'Paarse Holle.' This variety is named for its dark-red seed skin. It is mostly 2-seeded with some 3-seeded pods, and moderately wilt-resistant. It matures in 100 days, or, according to the natives, in 3 months."

55810. "(No. 71.) 'Toeban.' This is grown by the Selectietuin here as their most productive strain. Unlike some of the kinds named 'Toeban' in other places, it has a white seed skin. It is, with one exception, of the early maturing strains the most resistant to the locally prevalent wilt, *Bacterium solanacearum*. It is of the bunch type, easily handled and harvested, and matures in 100 days, or, according to the natives, in 3 months."

ARISAEMA sp. (Araceae), 55777. From China. Tubers collected by J. F. Rock, Agricultural Explorer of the Bureau of Plant Industry. "(No. 5053. Mili, Szechwan. July 12, 1922.) Tubers of an aroid of great beauty collected in the mountains. The large spathe is white with a tinge of pale green towards the apex." (Rock.)

CALLIANDRA TERGEMINA (Mimosaceae), 55790. From Dominica, British West Indies. Seeds presented by Joseph Jones, curator, Botanic Gardens, Dominica. "A small native tree known locally as 'Bois Ravine'; it makes a good hedge plant, and is very pleasing when in flower." (Jones.)

A beautiful leguminous shrub, of the habit of the mimosas but thornless, with compound leaves composed of 6 leaflets arranged characteristically in two groups of three each. The long purple filaments of the dense axillary flower heads make this shrub a very pleasing ornamental. (Adapted from Plumier, Plantarum Americanarum, ed. Burmann, pl. 10.)

CASTANOPSIS ARGENTEA (Fagaceae), 55811. **Chestnut.** From Buitenzorg, Java. Seeds presented through Carl Hartley. "(April, 1922.) An edible chestnut obtained from the head forester at Palembang, Sumatra." (Hartley.)

An evergreen tree 50 to 60 feet high, with narrow, thin leaves 5 to 7 inches long and very spiny dense clusters of burs; each bur is about 2 inches wide, and contains normally a single nut an inch in diameter. (Adapted from Hooker, Flora of British India, vol. 5, p. 621.)

CUCUMEROPSIS MANNII (Cucurbitaceae), 55792. **Kiffy.** From Freetown, Sierra Leone, West Africa. Seeds presented by Prof. Wm. N. Martin, Albert Academy, Freetown. "The gourdlike fruits, about the size and shape of a goose egg, are produced on vines like that of the ordinary gourd. The seeds when parched and ground produce a delicious condiment, and 'kiffy' seed is an important ingredient in the popular Liberian dish called 'dumboy.' The flavor of the parched seed is similar to that of the parched seeds of *Sesamum indicum*, which are used in the same manner by the natives of Liberia. The seeds are obtained by macerating the fruits in water and then washing the seeds free from the pulp. This plant probably would mature its fruits only in the extreme southern United States." (G. N. Collins.)

CUCUMIS MELO (Cucurbitaceae), 55766. **Muskmelon.** From Burringbar, New South Wales. Seeds presented by B. Harrison. "Seeds of the Australian casaba, which I believe originally came from India. It is a most prolific plant, bearing cream-colored fruits about the size of a cucumber. It is sometimes called 'apple melon,' and is quite popular here, being very palatable when eaten with sugar or made

up into pies. It is hardy, prolific, and early, and should thrive well throughout the United States." (B. Harrison.)

ELAEAGNUS MULTIFLORA (Elaeagnaceae), 55771. Gumi. From Komaba, Tokyo, Japan. Seeds presented by Prof. M. Shirai, Botanical Institute, College of Agriculture, Komaba. "Ogumi." A very attractive white-flowered Japanese shrub about 6 feet high. The lower surface of the oval leaves is silvery white and the dull red oval fruits, about an inch in length, are much relished for their brisk tart flavor, being excellent for preserves. (Adapted from The Florists' Exchange, vol. 38, p. 185.)

HYPERICUM CANARIENSE (Hypericaceae), 55754. From Nice, France. Seeds presented by Dr. A. Robertson Proschowsky. "A small graceful tree with drooping branches, which will grow on the driest and poorest of soils. The wood is the strongest I have ever seen; it is almost impossible to drive a nail into it. The boys here use its thin straight stems as net handles, all other kinds of wood breaking under the strain of pushing the net through the water. I should think that such remarkably strong wood which can be produced on such poor soil would have a practical value." (Proschowsky.)

LILIUM spp. (Liliaceae), 55751, 55752, 55756, 55770, 55778-55780. Lily. From China. Bulbs collected by J. F. Rock, Agricultural Explorer of the Bureau of Plant Industry. Quoted notes by Mr. Rock.

55751. "(Mili, Szechwan. July, 1922.) A tall plant with purplish white flowers borne in two's or three's, collected in the mountains."

55752. "(No. 5054. Mili. July 12, 1922.) A rather rare species with pink flowers speckled with purple, found in the mountains at an altitude of 12,000 feet."

55756. "(No. 4931. Likiang. July 7, 1922.) A beautiful lily with thick, oval, alternate leaves which are far apart. The single terminal flower has rich pink reflexed petals spotted with dark purple. This rare plant grows on the edge of pine forests of the Likiang snow range at an altitude of 12,000 feet. This may be only a variety of *Lilium duchartrei,* but it is a decidedly handsome plant."

55770. "(No. 5051. Mili. July 10, 1922.) A lily related to *Lilium duchartrei,* with large racemes of white flowers; the petals are reflexed and sprinkled with purple. The bulbs were collected in southwestern Szechwan, in the mountains of the Lama Kingdom."

55778. "(Likiang, Yunnan. July, 1922.) Bulbs of a lily with red stems, dark-green leaves, and yellowish red flowers; the reflexed petals are spotted with purple. This lily was found on the western slope of the Likiang snow range, at an altitude of 14,000 feet."

55779. "(Likiang, Yunnan. July 20, 1922.) A small lily with single white flowers; found on the Likiang snow range at an altitude of 14,000 feet."

55780. "(Likiang, Yunnan. July, 1922.) A lily with red stems and thick, fleshy, light-green leaves, collected on the eastern slope of the Likiang snow range at an altitude of 14,000 feet. The yellowish green flowers are marked with purple stripes."

MANGIFERA ALTISSIMA (Anacardiaceae), 55812. From Manila, Philippine Islands. Budwood presented by Sr. Adn. Hernandez, director, Bureau of Agriculture. A Philippine relative of the mango, which is found wild from northern Luzon to southern Mindanao, where it forms a large tree sometimes reaching a height of 116 feet. The tree is not cultivated, although the mangolike, smooth, green or yellowish fruits, 2 to 3 inches long, are used for making pickles. The leaves are long, narrow, and pointed at both ends, and the small, fragrant, white flowers are borne in large numbers in branched clusters. (Adapted from W. H. Brown, Wild Food Plants of the Philippines, p. 94.)

OSYRIS ALBA (Santalaceae), 55791. From Nice, France. Seeds presented by Dr. A. Robertson Proschowsky. "A small evergreen bush which is very ornamental when loaded with its red fruits. It grows in very poor soil." (Proschowsky.)

A small upright shrub 3 feet high, widely distributed throughout the Mediterranean region. It has stiff, narrow, yellowish green leaves, small axillary greenish yellow flowers, and small red fruits. The roots and fruit possess astringent properties. (Adapted from Schneider, Illustriertes Handbuch der Laubholzkunde, vol. 1, p. 247.)

PAULLINIA CUPANA (Sapindaceae), 55738. **Guarana.** From Rio de Janeiro, Brazil. Seeds presented by Dr. J. Simao da Costa, through Dr. W. L. Schurz, Commercial Attache of the American Embassy. A stout, bushy vine found wild in Venezuela and northwestern Brazil, and also cultivated in the latter country for the sake of the grapelike fruits, from which is obtained the product known as guarana. This, in the form of a black paste, has received considerable attention in the pharmaceutical world in recent years as a natural source of caffein.

The following analysis shows the composition of guarana:

	Per cent.
Caffein	5.388
Essential oil	2.950
Resin	7.800
Coloring matter,	1.570
Saponin	0.060
Guarana-tannic acid	5.902

Pyro-guarana acid	2.750
Starch	9.350
Glucose	0.777
Pectic acid, malic acid, dextrin, etc.	7.470
Vegetable fiber	49.125
Water	7.650

Owing to the fact that guarana is so rich in caffein, a small dose enables a man to endure an extraordinary amount of hardship, and taken sparingly it is said to be excellent for intestinal trouble.

The Mauhe district of Para, Brazil, produces about 25 tons of guarana paste annually, and cultivation of the plant has recently been undertaken in the states of Goyaz and Rio de Janeiro.

A number of new and successful pharmaceutical compounds contain this product. (Adapted from Bulletin of the Pan American Union, vol. 51, p. 268.)

PRUNUS TOMENTOSA (Amygdalaceae), 55781. **Bush cherry.** From China. Seeds collected by J. F. Rock, Agricultural Explorer of the Bureau of Plant Industry. "(Likiang, Yunnan. July 18, 1922.) A shrubby cherry which grows on the Yunnan-Szechwan border about 5 days' journey north of Likiang in the scrub forests near Fengkow, not far from the Yangtze River, at an altitude of 11,000 feet. The plant is 8 to 10 feet high, with a gray pubescence, branching from the base and forming a large, round bush. It is a most prolific bearer, and in the latter part of July is loaded with the oval orange-yellow cherries of a sweetish sour flavor." (Rock.)

PRUNUS spp. (Amygdalaceae), 55757-55761, 55782-55784. From China. Seeds collected by J. F. Rock, Agricultural Explorer of the Bureau of Plant Industry. Quoted notes by Mr. Rock.

55757. **Cherry.** "(Likiang, Yunnan. July 6, 1922.) A smaller tree than the following, No. 4858 (S. P. I. No. 55758); the fruits also are smaller, globose, and dark red. It grows in the Likiang snow range at an altitude of 12,000 feet. The tree is apparently free from any disease."

55758. **Cherry.** "(No. 4858. Likiang, Yunnan. July 6, 1922.) A fine looking cherry tree 35 to 40 feet in height, which grows at an altitude of 12,000 feet among limestone boulders on the edge of alpine meadows on the Likiang snow range. The foliage is dark green, and the orange-red, oval, pointed, sour fruits are much sought after by birds and hence difficult to collect."

55759. **Plum.** "(Szemao, Yunnan. July, 1922.) A plum tree of fine shape, 40 to 50 feet in height, growing in the mountains at an altitude of 5,000 feet or more. The small yellow fruits, about the size of an

olive, are not very sour; the flesh is scanty but quite tasty. Owing to its freedom from disease and prolific bearing, this species should be suitable for stocks."

55760. **Plum.** "(Szemao, Yunnan. July, 1922.) A plum tree growing in the mountains at an altitude of 5,000 feet. Owing to its prolific bearing and freedom from disease, this species should be suitable for stocks."

55761. **Plum.** "(Szemao, Yunnan. July, 1922.) A plum tree 30 to 35 feet in height, growing in the mountains at an altitude of 5,000 feet or more. The fruit, somewhat larger than an olive, is yellow, hard, and sour. Owing to its freedom from disease and prolific bearing, this species should be suitable for stock."

55782. **Cherry.** "(No. 5052. Mili, Szechwan. July 10, 1922.) A fine spreading tree 35 to 40 feet in height, collected in the mountains at an altitude of 12,000 feet. The small, oval, red fruits have very small seeds. The tree should make a good stock plant."

55783. **Plum.** "(Near Puerhfu, Yunnan. July, 1922.) A fine tree which bears bright-yellow, very juicy fruits of mild, sweet flavor, the size of a small apple. This species could doubtless be improved."

55784. **Plum.** "(Near Puerhfu, Yunnan. July, 1922.) A tree 35 to 40 feet high, with bright-yellow, slightly bitter fruits the size of a small walnut."

RHEUM RHAPONTICUM (Polygonaceae), 55789. **Rhubarb.** From Ottawa, Canada. Crowns presented by Prof. T. F. Ritchie, Department of Horticulture, Central Experimental Farms. "A new variety of rhubarb of very fine quality; it has a slender purplish stalk." (W. A. Orton.)

RUBUS GLAUCUS (Rosaceae), 55788. **Andes berry.** From Guatemala. Seeds presented by B. M. Young, Morgan City, La. "The Andes berry occurs as a wild plant from Mexico to Ecuador. It is a vigorous, raspberrylike plant, bearing maroon-colored fruits which resemble loganberries in flavor, but are sweeter. It can probably be cultivated on the Pacific coast and in the Gulf States. A full description of the plant, its cultivation and uses, may be found in the Journal of Heredity, vol. 12, pp. 387-393. November, 1921." (Wilson Popenoe.)

RUBUS MICROPHYLLUS (Rosaceae), 55774. From Komaba, Tokyo, Japan. Seeds presented by Prof. M. Shirai, Botanical Institute, College of Agriculture, Komaba. A much-branched shrub with slender climbing branches and scattered, recurved prickles. The roundish bright-green leaves are 5 or 6-lobed, and the solitary axillary pure-white flowers are followed by yellow juicy fruits nearly an inch in diameter. (Adapted from Curtis's Botanical Magazine, pl. 7801.)

RUBUS spp. (Rosaceae), 55785-55787. **Raspberry.** From Yunnan, China. Seeds collected by J. F. Rock, Agricultural Explorer of the Bureau of Plant Industry. Quoted notes by Mr. Rock.

55785. "(Likiang. July, 1922.) A rambling shrub collected on the Likiang snow range at an altitude of 15,000 feet in exposed situations covered with snow in winter and early spring. The entire plant is woolly-white and slightly spiny, and the leaves are snow white beneath. The fruits, the size of a thimble, have a sweet, delicious flavor, and the individual drupelets are large and transparent."

55786. "(Likiang. July 20, 1922.) A climbing shrub, with leaves silvery beneath and green above, growing on the Likiang snow range at an altitude of 13,000 feet. The orange-red berries have a sweet subacid flavor and attractive color."

55787. "(Likiang. July 20, 1922.) A shrub 5 to 6 feet high, collected on the slopes of the Likiang snow range at an altitude of 13,000 feet. The small leaves are green on both sides and the scarlet berries are sweet and very palatable."

Notes on the Behavior of Previous Introductions.

A recent Department Circular (No. 208, October, 1922) by H. V. Harlan and M. N. Pope, of the Office of Cereal Investigations, and L. C. Aicher, of the Idaho Agricultural Experiment Station, is entitled "Trebi Barley, A Superior Variety For Irrigated Land." Trebi barley (*Hordeum vulgare pallidum*) is a pure-line variety descended from a selection of a single plant. The original importation of this plant (S. P. I. No. 15821), was from Samsoun, Asiatic Turkey, in 1905. It is probable that the original barley was grown under irrigation in one of the small valleys south of the Black Sea. The Trebi is a 6-rowed barley with heads very similar to those of Coast barley. At Aberdeen, Idaho, the plants are two or three days earlier than Coast and slightly shorter. The kernels are large and bluish, and the awns break off from the kernel more easily in thrashing than those of the Coast variety. The grain is readily used for all farm or manufacturing purposes except pearling.

The summary of this circular reads as follows:

Trebi is a new variety of barley now just being distributed to American farmers. This variety originated from a single plant from a stock of seed imported from the southern border of the Black Sea.

It is especially adapted to irrigated conditions in southern Idaho and is recommended for irrigated lands where the summer season is similar to that in southern Idaho. A large percentage of the barley crop of the irrigated districts adjacent to Aberdeen, Idaho, now consists of this variety.

At present Trebi barley is not recommended for use on nonirrigated

lands. It has given good yields and appears to be a promising variety in some sections without irrigation, but it has not been tested a sufficient length of time to determine its value under these conditions. Until it has been tested more fully there is no assurance that it will be superior to the varieties already grown on nonirrigated lands.

Notes from Agricultural Explorers in the Field.

Mr. J. F. Rock writes from Nguluke, Likiang, China, August 25, 1922:

Since my return to the slopes of this beloved mountain I have been up to a height of 17,200 feet; the view from up there down the tremendous Yangtze gorge, 14,000 feet straight below me, is wonderful. On one side enormous mountain ranges extend to the east, with the Yangtze again on the other side but not visible owing to the distance (2 days' journey), and the mighty snow peak with an ice and snow wall 3,900 feet above me. This mountain is as steep as the walls of a house, with here and there alpine meadows perched between mighty limestone crags. The crags are gardens themselves, the plants are innumerable; the lovely saxifrages, beautiful composites, edelweiss, aconites, delphiniums, roses way up there (they were in fruit but not quite mature), junipers, gentians, senecios, campanulas, Codonopsis, Gnaphalium, and a host of others too numerous to mention. The crowning plant of all, the last vegetation encountered on these mighty limestone crags, is a composite, *Saussurea gossipiphora*. It is about 18 inches high and the whole plant forms a cone about 8 inches in diameter and packed with cotton; it looks like a sugared pudding. The flowers, which are purple, are hidden in this cotton wool and have to be searched for deep in the wool. The leaves form a basal rosette. There is another species here, smaller and less cottony; it grows in open loose limestone gravel also at 17,000 feet and does not descend lower. I am mailing you tomorrow several packages of seeds. The most noteworthy is a Rubus, the finest and most delicious of the range. I am packing the seed in 3 different ways to be sure that it gets there alive. I have sent you seeds of this plant before, but these come from fine plants found in a *Larix potanini* forest at an altitude of 13,000 feet. Be sure and get it to grow. The species is as yet unnamed, as I understand from Forrest. Next is *Paeonia delavayi*, a beautiful shrub 4 feet high with very deep crimson flowers 3 inches across; it grows among limestone boulders and also in alpine meadows from 10,000 to 13,000 feet. Then there is a lovely Lonicera, I do not know the species. It is not a climber but a shrub or more often a tree 20 feet in height, with a trunk a foot in diameter. The flowers are a deep orange-yellow with a paler lower lip. It is common here at 9,000 to 10,000 feet. Next *Ribes glaciale*, a lovely compact shrub 12 to 15 feet in height, now loaded with the red berries. The flowers are often pink and cream colored. It grows at 12,000 feet in

alpine meadows, often at 13,000 feet in fir forests, and at times develops into a small tree. The berries are palatable but nothing to brag about. It may be a good stock plant or an ornamental. There is also a wild plum from the limestone range opposite the snow range on the other side of the Likiang Valley; it grows at an altitude of 11,000 to 12,000 feet. This limestone range is exceedingly dry and hot from April to July, then the rains commence but the water is absorbed as if the ground were a sponge. Then later come ice, frost, and snow, with a dry cold wind. This plum is a handsome little tree, 20 feet in height, with yellow (orange-yellow) globose plums about an inch in diameter; the flesh is very firm, acid to somewhat sweet when fully ripe. It will be good as a stock plant in semiarid alkaline regions. I found only two trees, but animals had already devoured much of the fruit, and I collected all that were left.

I am sending *Helwingia rusciflora* merely because it is one of the most curious plants I ever saw. It is a shrub 15 feet in height (I have not seen it in flower) and has ovate elliptical leaves, glossy with prominent midribs, and bears its fruits on the upper surface in the very center of the leaf on a pedicel about 2 mm. long. The fruits are purple and contrast well against the bright-green foliage.

I am also sending seeds of two Primulas. One is exceedingly handsome (*P. vinciflora*), with flowers of a deep indigo-blue, 1½ inches wide. The other is *P. sino-purpurea*, with large umbels of purple flowers. It is a very robust plant often 3 feet high, with golden tomentum on the under surface of the leaves. I photographed it when in flower. These primulas like peaty, boggy meadows, at an altitude of 14,000 feet, with plenty of tannic acid in the soil water. In fact, the seeds do not readily germinate; they are covered with a film which is dissolved either by hot water or tannic acid. Only when so treated will the percentage of germination be good. Next several varieties of a rose (*Rosa* sp.). There are here at least 30 varieties of this rose. They are all exceedingly handsome, some white, others cream colored, pink mauve to purplish, and all of course single. They are all shrubs. Some varieties are found as high as 15,000 to 15,500 feet and as low as 10,000 feet. The seeds I am sending came from an altitude of 12,000 feet. There are many other roses here, and I shall send you a little later seeds of all of them, if possible. Day before yesterday I crossed a limestone range 12,000 feet in height and descended into a lovely meadow about 2 miles long by half a mile broad, surrounded by mountains. In the meadow are many sink holes filled with water; hence the name "Chin hai tze," or "nine seas." There I discovered a wild pear, at 11,000 feet altitude growing up to its branches in water; perfectly healthy, spineless, and loaded with small pealike fruits (all seed). Unfortunately the fruits were not ripe, but I am going to get them later. Another species of wild pear I found on the Lashipa plain,

2 days' journey west from here. I am also going to get it.

There are many interesting and beautiful leguminous shrubs, one especially handsome, *Indigofera pendula,* with long (over a foot) racemes with large purple and silky gray flowers. There are two wild hazelnuts here. One is a tree 60 to 80 feet in height, with a trunk 3 feet in diameter. This species is, however, rare. I found only 2 trees and shall get all the seeds I can of it. The latter is a true Corylus, the other is a shrub.

There are many gorgeous rhododendrons here, and I shall endeavor to get seeds. Viburnums are plentiful, some make good jam and are very ornamental when in fruit. There is a true lilac, *Syringa yunnanensis,* with pink flowers, occasionally white or lilac. Some of the conifers, such as *Abies forresti* and *Abies delavayi,* are very handsome trees indeed. There are *Pseudotsuga, Tsuga, Larix potanini,* and a *Picea* which reminds one of Dacrydium in habit. It is *Picea likiangensis,* but it is a scanty seeder. There is a fine Lonicera (*L. xerocalyx*), a shrub with horizontal branches and rich golden orange-yellow flowers; a shrub worthy of cultivation. Other plants of which I shall send you seeds are *Meconopsis integrifolia,* -a poppy with huge golden yellow satiny flowers, and a beautiful Buddleia (*B. forresti*), -a purely limestone plant. And best of all two wild pears from this snow range, with crimson fruits; a wild quince with oblong fruits; more wild peaches, plums, various rosaceous trees as Sorbus and Photinia, also Quercus, wild olives, and wild walnuts. In fact there is so much that one does not know where to begin first. For example, there is a delicious wild gooseberry 3 days' journey from here; the fruits are larger than those of our cultivated varieties and are delicious. I shall try to get it.

Simple Appliances For Ridding Soil of Nematodes and Other Organisms.

Beverly T. Galloway.

Growers of rare and valuable plants, seeds, bulbs, cuttings, etc., are finding it more and more important to rid the soil, sand, or other media used, of nematodes, grubs, insect eggs and larvae, and certain fungous organisms. This is particularly true if one is distributing or exchanging such plants, for it removes certain restrictions and objections on the part of those charged with the enforcement of plant quarantine laws and regulations. Aside from these important considerations, soil treatment such as here described has been found beneficial in the case of a great many different kinds of plants. Growth is more vigorous, and stronger and better plants are the result.

It should be understood that we are not concerned with complete soil sterilization. For certain limited uses in the laboratory this

is important. Our problem has been to find simple, practical methods of freeing soil in considerable quantities from nematodes and some of the more common destructive fungi and related organisms. We have had the further problem of doing this work in such fashion that the chemical, physical, and biological properties of the soil would be disturbed as little as possible. Many of the new plant introductions brought in by the Office of Foreign Seed and Plant Introduction must be grown in quarantine. Many others are grown at our field stations for distributing to collaborators and others, and in all cases we endeavor to free the soil of any enemies that might prove dangerous to other sections of the country. While the appliances and methods described are designed primarily to meet our own needs, they have been developed with the idea of aiding others, especially experiment station workers and our collaborators. In the course of our work we have used some of the special devices designed for soil sterilization. We have not found them entirely satisfactory. Aside from their first cost, which is considerable, there are other factors, such as the ease of handling the soil, and more important than all, the effects on the soil itself. Some of the devices may render the soil practically unfit for the growing of plants. They often puddle the soil and may greatly change its physical and biological properties.

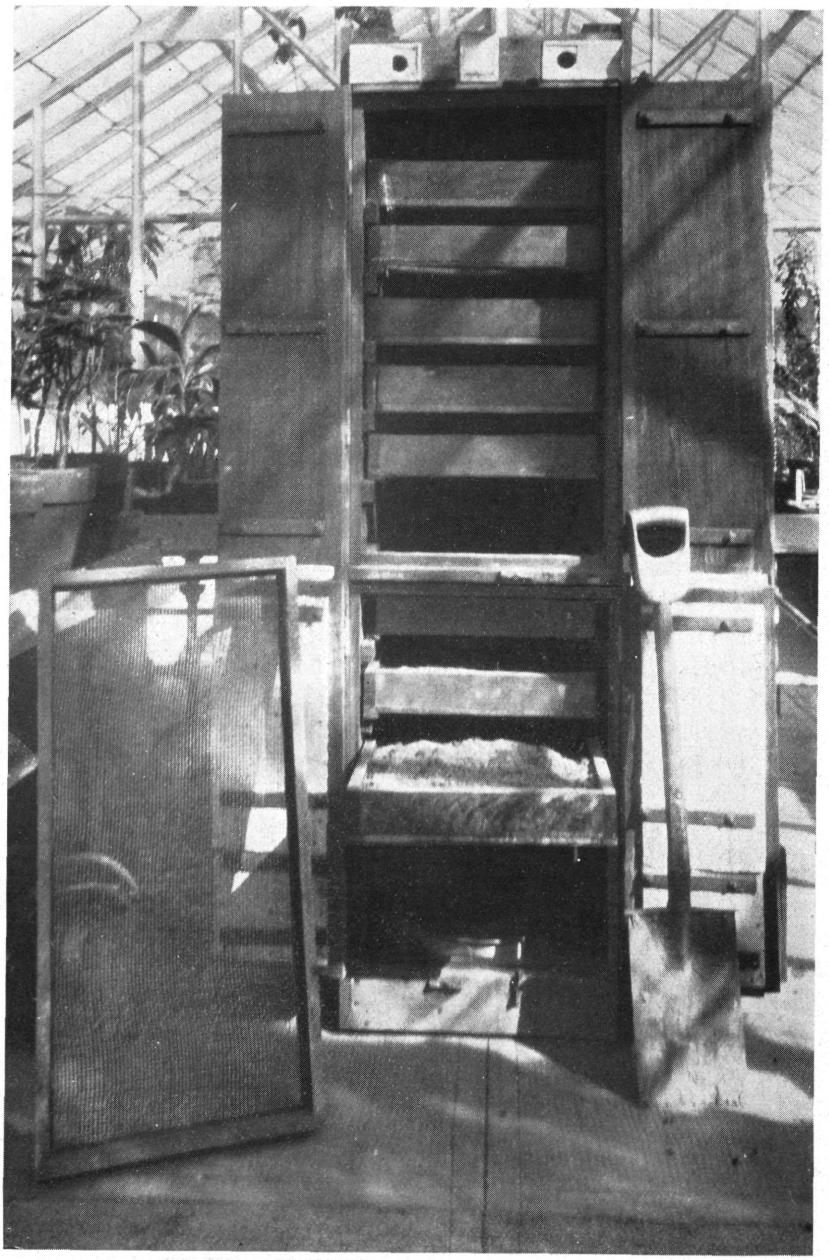
It will suffice to describe briefly the appliances, and then by means of photographic reproductions accompanied by short specifications, anyone with a little mechanical ingenuity should be able to make them or have them made.

1. **The Cabinet Method.** (Pl. 317.) The apparatus used is a simple, tight wooden box made on the order of a cabinet. It is designed for use where low pressure steam is available, such as is used in greenhouse or dwelling house heating. The box is filled with drawers which slide on wooden cleats screwed or nailed to the inside of the box. The size of the box or cabinet must be made to accommodate the number of drawers to be used. Any number of these cabinets may be constructed, the number depending on the quantity of soil it is desired to treat. The cabinet illustrated in Figure 1 holds ten drawers, each drawer having a capacity of one-half bushel of soil. Five bushels of soil may, therefore, be heated at one time. We take our steam for this cabinet from one of the greenhouse flow pipes. A one-inch connection is made to the flow pipe, to which is attached a one-inch globe valve. A nipple and reducer provide an attachment for a piece of ordinary three-quarter inch garden hose. After the drawers are filled with soil they are placed in the cabinet and the doors are closed and securely fastened. The steam is introduced by means of the hose through a hole in the bottom of the cabinet. The condensation is collected in a pan or it may simply be allowed to leak out at the

bottom of the cabinet. With four to five pounds of pressure it requires but a slight turn of the valve to give all the steam needed. If too much steam is turned on, there will be considerable leakage and this is to be avoided. We make our drawers so that when slightly heaped they hold, as indicated above, just about half a bushel of soil. This is as much soil as one wants to lift about. Those who have had the experience of lifting two or three bushel bags of sloppy soil out of an autoclave know something of the back-breaking feature of this job. Furthermore, breaking the soil up in small quantities gives the steam opportunity to penetrate it. This is further aided by the wire mesh bottom of the drawers. A piece of single thick burlap is placed in the bottom of each drawer.

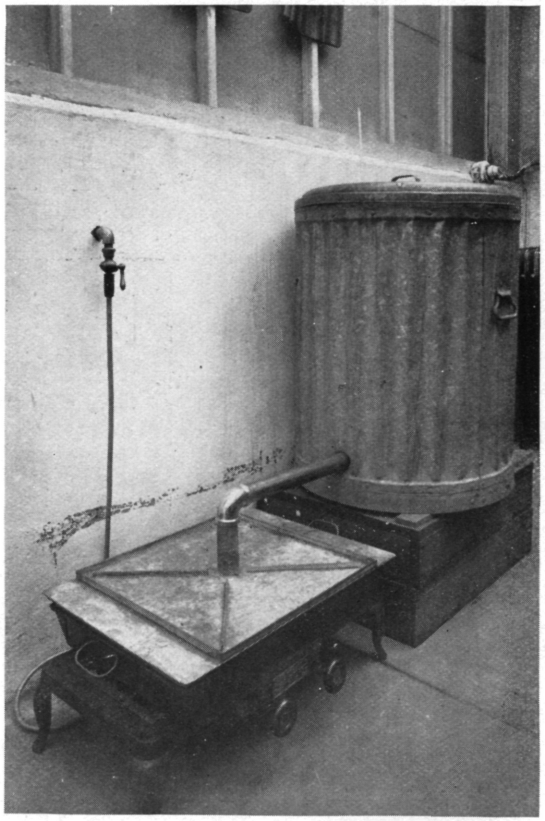
The drawers when put into the cabinet are staggered - that is, the first drawer at the bottom of the box or cabinet is pushed all the way in, the second is left about an inch from the back of the box, and the next one is pushed in. This gives the steam a chance to follow up, over, and under each drawer. We find by experience that one hour's steaming as described will effectively destroy nematodes and mycelium and spores of the more common fungi infesting the soil. The temperature of the treated soil for the last thirty minutes will average 80° to 85° C. Many tests have been made with the common nematode, *Heterodera radicicola*. Fragments of infested roots and the whole root growth of numerous plants badly infested with the nematodes have been buried in the soil and subjected to the treatment as outlined. In all cases the nematodes have been killed. Furthermore, no nematodes have been found on the roots of plants grown in treated soil, although thousands of plants have been examined. Soil treated by this method does not become soggy. It comes out of the cabinet in excellent physical condition, mealy, and of good texture. No good gardener will object to it as a potting soil if it is in good condition when put into the apparatus. The soil should not be steamed when overwet.

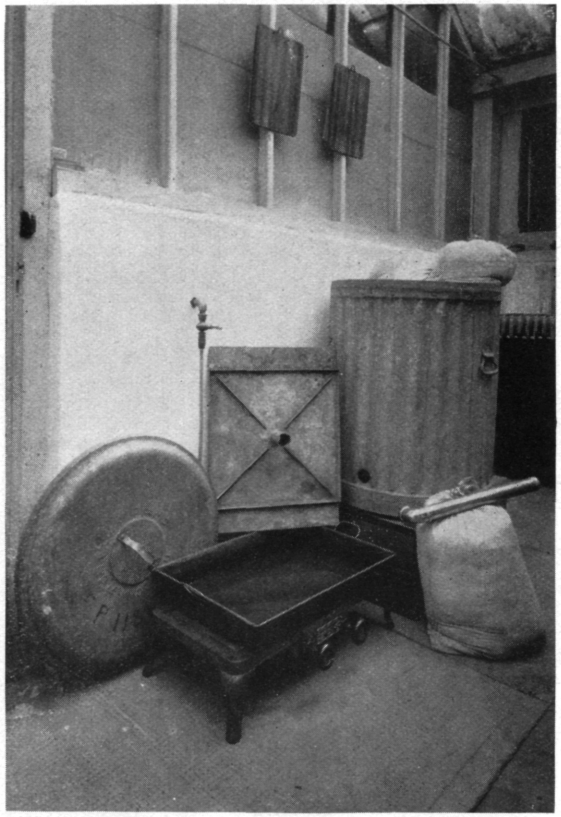
2. **The Can Method of Soil Treatment.** (Pl. 318.) There are many places and times when it is important to treat a small quantity of soil and when steam boilers are not available or in operation. To meet such a contingency we use a simple and inexpensive outfit consisting of a large galvanized can provided with a lid, a simple steam generator consisting of a baking pan provided with a special lid, and a two-burner oil or gas stove. The apparatus assembled and taken apart is shown in the figure. The steam generating part of this apparatus was developed by the Dairy Division, Bureau of Animal Industry, U. S. Department of Agriculture, and is designed primarily for the sterilization of milk cans and milk receptacles. The soil to be heated is properly mixed and sifted, and then put in half-bushel bags. A false bottom made of wooden slats is put in the galvanized can. The false bottom stands



CABINET FOR SOIL TREATMENT WITH STEAM

Height 5 feet 10 inches, depth 3 feet 2 inches, width 18 inches, all inside measurements. Length of drawer 3 feet, width 17¾ inches, depth 3⅜ inches, all outside measurements. Size of wire mesh on bottom of drawer, one-fourth of an inch. The box is made of 1-inch lumber; cleats 1 inch square. Each drawer has a countersunk trunk roller at each corner, so as to make it pull out easily; the trunk rollers cost 50 cents per dozen. Doors braced with 1-inch strap iron to prevent warping. The two 2-inch holes at the top of the box, covered with tin slides, are for the purpose of driving out the cold air when the steam is first turned on. The 1-inch hole at the bottom is for the insertion of the steam hose. (Photographed by E. L. Crandall, Inspection Greenhouse, April 5, 1919; P25020FS.)





CAN METHOD OF SOIL TREATMENT WITH STEAM

Can of heavy galvanized iron, 20 inches in diameter and 25 inches deep inside. Pan black iron, 20 inches long by 14 inches wide and 3 inches deep. Lid 20½ inches long, 15¼ inches wide, 1 inch thick. Steam pipe 1¼ inches in diameter. Lid must be made of two layers of galvanized iron with 1 inch asbestos between. A half-inch edge is made around the bottom of the lid and this fits inside of the pan to make a tight joint. (Photographed by E. L. Crandall, Inspection Greenhouse, June, 1918; P24031, 24032FS.)

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above the opening for the admission of the steam. The can will hold six half-bushel bags, or three bushels of soil. Four quarts of water are placed in the pan, the tight-fitting cover is put on, and the pipe for conducting the steam to the can attached. (See figure at left.) The gas or oil stove is lighted and the steam begins to form in about five minutes. The apparatus will evaporate about four quarts or eight pounds of water in an hour. This is equal to nearly a fourth-horse-power boiler. It requires about three hours of steaming with the apparatus to bring about the desired results in the soil. For the last half hour of the steaming the temperature of the soil inside the bags runs from 75° to 80° C. It is necessary to keep adding water to the pan, as the best results in steaming are secured when about four quarts of water or less are in the receptacle. The contrivance could easily be made so that the water of condensation returns to the pan. Extreme simplicity is the chief consideration, however, so that the return of the water is not regarded as important. The condensed water remains in the bottom of the can or runs out of the hole for the admission of the steam pipe. The leakage of steam around this hole is negligible. Soil treated in this apparatus does not become water-logged and in every respect is as good as that from any of the other devices we have used. For field and laboratory purposes, for small growers with frames and greenhouses, and for others who may be desirous of producing clean, strong, healthy plants, this apparatus will be found useful and convenient, especially where gas is not at hand. The apparatus may be used for sterilizing dishes and other appliances and could be utilized for cooking and canning. With a two-burner blue flame oil stove, one gallon of kerosene will run the apparatus for eight hours and will evaporate thirty to thirty-two quarts of water at an expense of fifteen cents. This means the treatment of seven to nine bushels of soil at a total cost of about fifteen cents, or about two cents per bushel. Using a two-burner gas stove it requires 200 cubic feet of gas for eight hours, costing fifteen cents, to evaporate thirty-two quarts of water. It will be noted, therefore, that the cost of oil and gas is practically the same on the basis of fifteen cents a gallon for kerosene and seventy-five cents per thousand cubic feet for gas.

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